

## Personal Statement – Ethan Davies

I would relish the opportunity to study for a PhD at the University College London in your CDT in Delivering Quantum Technologies, focusing on the theoretical aspects of quantum computing and information and how they would affect quantum technologies. After completing my A-levels, obtaining A\* A\* A A A\* (in Further Mathematics, Mathematics, Physics, Chemistry, and the Welsh Baccalaureate respectively) and 1,1 in STEP 2 and 3, I went on to obtain a first-class Bachelor's degree in Mathematics at the University of Cambridge.

For the first year I took a range of pure and applied mathematics courses, then finding myself drawn to a range of topics such as Variational Principles, Numerical Analysis and Asymptotic Methods, where I found deriving solutions to problems extremely satisfying and achieved the maximum number of quality marks available for these in the exams. I also took courses in Quantum Mechanics, focusing on understanding the postulates and exploring the implications thereof; for example, I enjoyed deriving the energy eigenstates of the hydrogen atom and constructed a rough sketch of the periodic table.

I also chose to do eight theoretical, computational projects with written reports (which were unsupervised). For these I independently learnt MATLAB, and LaTeX. One of the projects, in which I received 95%, entitled "Random Binary Expansions Distributions" where I constructed the distribution, computationally found properties of the distribution, and subsequently proved my propositions with rigour. Problems like this, where pure mathematical ideas were used to obtain applicable results, made the project greatly rewarding. I strongly believe that my mathematical background forms a solid foundation for the theoretical research that I hope to pursue.

Thanks to these projects and learning courses in advance over the summer (allowing me to study more topics), I have acquired the ability to stay motivated for longer stretches of time and enjoy working independently.

In my third year, I was able to take my first lecture course on Quantum Computing taught by Richard Jozsa, learning a simple yet astounding fact: our world is not classical. Therefore, to get the most out of our technology, we must utilise the framework of quantum mechanics. This led me down the route of taking all opportunities to study and understand Quantum Computing and Information.

Since then, I obtained a first-class degree (also obtaining a scholarship and college prize from Robinson College) and am currently working towards my MMath also at the University of Cambridge, where I am taking all available courses on Quantum Computation and Information. I am currently writing an essay entitled "Variational Hybrid Quantum-classical Algorithms", for which I am reading recent papers on the variational quantum eigensolver method and summarising them, with the possibility of creating new research in the process.

I have also begun reading and working through the book "Quantum Computation and Quantum Information" by Nielsen and Chuang, wherein it surprised me in how few situations (that we know of) quantum computing yields a complexity reduction, highlighting how much more there is to research at this stage.

Outside of academia, I enjoy running (having completed 5 half marathons), chess and playing rugby in my college team, teaching me perseverance, discipline, and teamwork.

The CDT in Delivering Quantum Technologies appeals to me for a variety of reasons. Until now, I have only studied quantum topics theoretically, so the opportunity to do lab work in the first year would give me hugely important insight into each topic, allowing me to see how theoretical and practical research goes hand-in-hand.

The opportunity to research in a department as big as the Quantum Science and Technology Institute in UCL makes it more achievable for me to research in an area of quantum computation that excites me most. Furthermore, it will also allow me to access a range of talks on quantum research from the department, but also from leading industry companies which would sustain my interest in the wider quantum field.

After completing this qualification, I aspire to undertake further research, studying the theory behind constructing quantum algorithms and protocols.