973/1000 words

I would like to apply for a DPhil at SABSR^3 because I want to push myself as far as I can in mathematics, I have a longing to understand more how our world works by using mathematical models to draw useful mathematical and biological conclusions. Throughout my childhood I have always loved mathematics but it seemed so formulaic which was not completely satisfactory for me. I wanted to know why and how; why this method was discovered or how it was useful beyond formulaic problems. Whilst the undergraduate course has been great in starting to answer these questions I really want to go further. I want to use what we had been taught at undergraduate level to apply it to real world problems in order to make a tangible difference. I want to understand in more depth therefore this DPhil would begin to quench my thirst in this area.

I believe that one of my greatest strengths is my ability to work individually and collectively. I am self-motivated and willing to put in the hard work as evidenced by me being one of the few people who continued to participate in online tutorials during the COVID-19 pandemic which enabled me to go deeper in my understanding beyond what was necessary for the course. My team skills can be shown by the example of my university badminton team. I am part of the elite performance programme for badminton at the [redacted] (one of only 8 such programs at the University). This has meant that throughout my degree I have had to balance both my degree and elite sport training, this requires planning and the ability to split my time effectively between multiple activities, both of these skills would be useful whilst studying for a DPhil. Also, I served as team captain and selected teams on multiple occasions which shows my willingness to make decisions, leadership skills and team-building skills. The ability to effectively communicate with people from multiple different backgrounds and work together for a common goal is very advantageous for a DPhil where often the path forwards is unknown.

One of the ways I have prepared for research is by providing statistical analysis for an innovative NHS service. This was published in the Centre for Mental Health in their publication "Now or Never" on 29th July 2021 (Pages 24-25). I have had the opportunity to apply, collaborate and communicate my mathematical skills in a biomedical clinical field. A more academic paper has been submitted to BMC Psychiatry and is awaiting peer review. This experience has given me an appreciation of the process by which research gets published.

I have a particular interest in modelling biologically relevant problems mathematically in order to draw useful mathematical and biological conclusions. In particular, I have an interest in the applications of bifurcation theory to dynamical systems; currently I'm doing a Masters research project supervised by [redacted] researching stem cell differentiation using zebrafish embryos as a model species. This has been very interesting and rewarding to research thus far. This has involved researching the current understanding of both the biological motivation as well as the mathematical models, in particular we are applying a very recent theory to the process by which stem cells differentiate seeking to resolve the previous two suggested models of Direct fate restriction and Progressive fate restriction into a new model called Cyclical fate restriction which uses more complicated bifurcations that arise from symmetries, we then provide a bifurcation analysis on ODEs that we develop to seek to provide some useful conclusions. I would value the chance to develop further the skills that this has begun to teach me, particularly in novel mathematics where the correct answer (if there even is one) is not known. The challenge of this alongside the problem solving and creativity that research requires is something I would delight in pursuing. This has also taught me that the style of mathematics done at undergraduate level is only a fraction of what is needed for research. You need to find a problem and understand the background before you can begin mathematics and even with the best intuition there is no

guarantee that your first, second or thirtieth idea will be the one that leads to a breakthrough. I believe that these interests are well suited to the 3rd theme of SABSR^3 Physical Modelling Underpinning Biomedical Discovery. I have made contact with [redacted] and [redacted] as both have some fascinating research areas. In fact it was in discussion with [redacted] that he suggested I apply for SABSR^3.

Oxford is the best place to do this as the combination of the prestigious nature of the University and the innovative research ethos of SABSR^3 means that if successful I would be surrounded by leading academics in the field who I could learn a lot from. Also, this would lead to further career prospects for me beyond the DPhil either in further academia or in the industrial workplace. The chance to learn from students and staff alike across multiple fields of science would also be very valuable. This would allow me to apply my mathematical training to relevant problems from across biomedical sciences in order to aid in a greater collective understanding. This would be something I'm sure that I would enjoy as mathematics is enjoyable anyways but to know that the maths that you are studying has real world applications would be a very rewarding experience. I believe that there is a necessity for mathematicians to work alongside our colleagues from other biomedical fields to work collectively using our own areas of expertise together to hopefully lead to a greater understanding and thereby make tangible differences to people's lives. Therefore, this leads me to wanting to apply to SABSR^3 where we can work together for a common goal.