Dear Washington University Admissions Committee,

During my studies in fundamental physics track, I worked with many physical models that explain nature from different perspectives; the Schrödinger equation, the Fermi gas, or weak gravitational lensing, are some of the ones I enjoyed the most. The physicist Murray Gell-Mann once wrote: *How can it be that writing down a few simple and elegant formulae, like short poems [...], can predict universal regularities of Nature?.* As I advanced into my junior year, I gradually came to appreciate the field of programming when I enrolled in courses such as Computational Physics, Statistics and Data Analysis, and Dynamic Systems and Feedback. Simultaneously, I started developing a deep interest in Astronomy when I took the course Extragalactic Astrophysics. My growing interest in these areas lead me to combine my computational skills with astrophysics in two of my research projects: my final thesis and my collaboration scholarship research project. My final thesis brought together all the research I did in my senior year at UNC. During that time, I was able to appreciate science in all its facets: from spending long nights at the telescope acquiring spectra, spending months analyzing data with Python, to presenting my results in research conferences such as the Conference of Undergraduate Research (CUR). I also enjoyed my time during the collaboration scholarship research project because it was an opportunity for me to bring out the astrophysical and computational knowledge I had acquired in the US. I came up with the idea of writing a machine-learning algorithm to tackle the problem of finding galaxies with very specific features that would determine some of the underpinnings of galaxy evolution. However, as much as I enjoyed research in computational astrophysics, I started asking myself how much impact my research would have in helping solve humanity's most pressing challenges, particularly climate change.

I was raised in an off-the-grid house in the countryside. From a very young age, my parents instilled in my brother and me the fundamental values of conscious consumption and respect for the environment. My research experience in the US made me reflect on the role I wanted to play in society regarding climate change as I grew older. Consequently, I decided to switch to the field of ecology and started the MSc Computational Methods in Ecology and Evolution (CMEE) at Imperial College London. While studying CMEE, I am reinforcing my computational skills, and being introduced to the world of theoretical ecology through my research in Metabolic Theory with Dr. Samraat Pawar. I am realizing now that the complexity of ecological systems makes it very hard for a theoretical approach. There is a sweet spot between the physicist's spherical cow[1] strategy to tackle problems (one that sacrifices realism to generality and precision) and the biologist's phenomenological way (one that sacrifices generality to realism and precision). The happy medium between the two strategies captures the complexity of real ecological systems from a mechanistic point of view. This delicate approach that brings together the best of both worlds is the one I believe will generate the most successful models.

I would like to extend my research on theoretical ecology with this perspective through a Ph.D. at Washington University. I am particularly interested in the work of Dr. Mikail

[1] A spherical cow is a humorous metaphor for highly simplified scientific models of complex real-life phenomena.

Tikhonov in unifying concepts like *species*, *organisms*, *ecosystems*... through a mathematical approach based on the increasing amounts of data we have. I believe his method of gradually adding structure to a fully disordered ecology without species, instead of treating the living world as a deviation from a perfectly clustered set of discrete species, is very promising. This ecology problem shares the same mathematics as the problem of tradeoffs and evolution in changing enviroments. The mathematical symmetry in such different topics points to the posibility of a unified theory of the ecology and evolution.

I am sure that this new theoretical approach to the microbial world will bring exciting discoveries that will change the paradigm of how we think about ecological communities. Furthermore, I truly believe that my international background in physics and ecology, along with the computational skills I have acquired during my undergraduate and master studies, make me a valuable addition to Dr. Tikhonov's lab, since I will bring an interdisciplinary point of view to tackle the next generation of problems in Theoretical Ecology.