My greatest personal interests are on the boundary between physics and pure mathematics. I find most fascinating the subtle ways in which simple ideas like counting, or theories about abstract mathematical objects like sets, numbers, and functions, reveal important and observable properties of the physical world we live in. I enjoy mathematical modelling of physical phenomenon because it is a unique opportunity to see directly how physics and mathematics interact, and because I want to further explore the fundamentally mathematical properties of nature. I am deeply interested in the theoretical and computational modelling sides of physics, and hope to contribute to further developing applications of pure mathematics to theories of physical relevance.

My fascination with the relationship between pure mathematics and physics became well-defined while I was a student in an experimental research group studying liquid crystal materials. A primary focus of our group was the study of how uniquely-shaped particles, such as figure-8s and 3-dimensional knots, interacted with the liquid crystal medium. In a branch of geometry that studies the intrinsic properties of shapes, a coffee cup and a doughnut are mathematically the same shape because they have one hole (the hole in your coffee cup is its handle). An interesting result of our experiments was that the properties of an object in liquid crystal are determined by its abstract mathematical shape (its number of holes) rather than by its apparent physical shape. Such surprising relationships have turned up with increasing frequency as I have continued my studies, and keep me always excited about my future in physics and mathematics.

I am currently a member of a research group that studies a newly-discovered material of great theoretical interest, quark-gluon plasma, which is created in high-energy collisions between heavy nuclei like lead and gold. Quark-gluon plasma is exceptionally difficult to study experimentally, so theory and computer modelling are of great importance to the progress of the discipline. Our group studies the material properties of quark-gluon plasmas theoretically and develops new methods in fluid dynamics that can be used to simulate them on the computer. In my current work, I am writing simulations of a similar fluid in order to more precisely determine the viscosity of quark-gluon plasma.

I thoroughly enjoy the opportunity to study the mathematics underlying fluid mechanics and numerical methods, and to apply these to an unsolved problem in physics. I am excited to contribute to research in high-energy physics because the discipline is very young and has many important consequences in modern physics. Quark-gluon plasma for example, first observed in 2000, is the first medium in which to directly study quarks, which are believed to be the fundamental unit from which matter is composed. High-energy physics also is essential to the study of the early universe and to the development of nuclear fusion energy. I am interested in continuing research in this discipline, and hope to contribute to the fundamental mathematical background for this area of physics.

My academic goal is to enter a PhD program in theoretical physics after my graduation from the University of Colorado. I hope to spend my career doing fundamental high-energy physics or nuclear fusion energy research at a university or national laboratory.