

# Statement of Purpose

## *An Applicant for the Physics Graduate Program*

My interest in Physics originates from my enthusiasm for thinking about questions and concentrating on a single problem for hours, which is the greatest joy of my life. Among various fields of Physics, I am interested in ..... for its connection with the most fundamental laws of nature and for some unique features of it, one of which is its high level of Pure Mathematics. Another feature is that, in various situations, a simple mathematical principle had solved a big puzzle such as the discovery of ....., leading physicists to explain the interactions between elementary particles. The unique mathematical structure of high energy and these two features form the essence of my interest in this field.

My academic life began when I entered the National Mathematical Olympiad in which I ranked ..... and won the gold medal. A year later, in the International Mathematical Olympiad, I won the ..... medal. However, apart from its enjoyment, I had no motivation in just solving pure mathematical problems and pursuing it as a career. I was looking for something practical—having to do with the outside world—yet as deep and challenging as mathematics, and Physics perfectly met the two aforementioned criteria. Having entered university, I learned about the deep relation between physics and mathematics, which became the most interesting subject that I wanted to learn about.

During my undergraduate studies, different courses led me toward my current interest. The most prominent of them was Advanced Particle Physics I for its amazing textbook—Quantum Field Theory and the Standard Model by M. D. Schwartz—and for the study group we formed with some graduate students to study it. With these students, we studied 70% of the book and solved its exercises throughout the academic year. This amazing experience provided me with a decent background about the subject, which further increased my interest in it. Furthermore, the great deal of time I spent on it and the numerous problems in which I got involved broadened my horizons about this field such that even the most tedious calculations now do not weaken my interest in it. After I passed this course, in Advanced Particle Physics II, I learned about theories beyond the Standard Model, particularly Supersymmetry and Grand Unification, which made me have a deeper understanding of Particle Physics.

In my university, there is barely a chance for an undergraduate student to have a research in high energy theory, so I just had one research experience with Quantum Computation and Quantum Information instructor, Professor ....., which was not much related to my current field of interest. Apart from this, I spent a summer in ..., in which I worked with the ... group under the supervision of ..... and under the supervision of Professor .....as the head of the group. We worked on the problem of ....., The technique we used was machine learning, or more specifically ....., which is a method for image recognition. Therefore, the data that was extracted from the calorimeter in the CMS detector changed into an image format. I programmed in .... language, in a way that the code could be run on .... Within two months, I managed to learn the concepts of neural networks and .... and then implemented them on the calorimeter data. Although our achievement, a mistag rate of 35% for the discrimination, was not a great result, there is hope that, with more investigation on this approach, this result could be further improved.

While most physical analyses look for the events that come from quark jets, most events originate from gluon background jets; thus, discrimination can vastly improve the efficiency of the analyses.

I had some advanced graduate courses such as Quantum Information, General Relativity, Algebraic Topology, and Differentiable Manifolds, in all of which I was one of the top two students. I also won the ..... medal in the International Mathematics Competition in the second year of my education. All these, together with various advanced subjects I studied, gave me enough experience to wisely decide about my future.

The fields of Physics I am interested in are various aspects of Quantum Field Theory, and as my interest lies in the relationship between Physics and Mathematics, I am really avid to learn about the aspects of Physics that involve Pure Mathematics at a very advanced level like ..... Another area of my interest is ..... and the relation between high energy and Quantum Information. Finally, various aspects of beyond the Standard Model phenomenology, such as Supersymmetry and the extra dimensions, also appeal to me.

..... University, for its prominent high energy theory group with several distinguished faculty members whose fields perfectly match my fields of interests, is the best institution in which I can pursue my research objectives. This is mostly because there are quite a few physicists working on .... Theory, and many others who work on beyond the standard model phenomenology whose research activities are quite similar to those of mine. I am particularly interested in the works of Professor .... in .... theory in general and in ..... in particular. I am also interested in the works of Professor ..... and ..... in .... Theory, particularly because of the relation between their work and gauge-gravity correspondence.

Generally, the prominent reason for my applying to ..... Graduate School is the opportunity for me to think about and research on what is interesting to me. I am determined to pursue my job as a full-time researcher or professor. I believe that studying in ..... calls for perseverance and hard work, so I think I can be considered as a suitable candidate to do so, as I can concentrate on a single problem for days and weeks to find a solution, which is similar to what I will encounter in the future.