Statement of Purpose

Benda Xu

CURIOSITY in science comes from my childhood, from the cute worms that can dance toward stimulation, from a magical stone ripped from a loudspeaker that can summon his special fellows out of sand, and from grandpa's stories about the mysterious patterns of blinking eyes in the night sky.

At primary school, I kept asking why it is the way it is. However, most of the answers were not satisfactory. Sometimes a question like "Does an apple we eat consist of live or dead cells?" could puzzle me for a long time and I did not know what to do except asking.

Things changed in my 14. I discovered my father's old college book chest and became addicted to the textbooks on mathematical analysis and general physics. I taught myself calculus and differential equations, as well as basic mechanical, thermal, electromagnetic and atomic physics. Since then I could think and calculate independently. **I wanted to be a scientist, a big man who can discover and understand even more and contribute to the human civilization**. I became the "master of science" in class and participated in all fields (mathematics, physics, chemistry, biology and informatics) of *National Olympiad* for high school students.

Due to the excellent academic performance in my high school studies, I came to Tsinghua University without entrance examination. Moreover, I was recognized and admitted to Nobel laureate Chen-Ning Yang's Academic Talent Program to study fundamental science of mathematics and physics.

In the first two years, asking "*What is the aim of my life?*" "*What is the significance of science?*" "*What is the spirit of mathematics and physics?*", I thought intensively about the value of man and science, read books, attended classes and debated with friends. Finally I made it clear and summarized the answers in sequence of essays.

I grew up into a rational and passionate youth via answering those vital questions. With such a firm philosophical base, I developed my own academic character and interest.

I have a natural aesthetic sense of abstraction. I like to hold on, think over, generalize my thought and apply it to areas that seem irrelevant. I believe in, as Roger Penrose described, Platonism: *There is a central ideal mathematical world standing behind physical reality.* I enjoyed rewriting all the deductions in my physics textbook in tensors or in differential forms. When discovering special functions can be studied algebraically as group representations, I was very excited to use such techniques to understand PDEs.

At the same time, **I developed an intuitive way to catch the meaning of physics.** Every physical process or phenomenon I learned can be called up lively, as if I can see, hear or smell it. I can often guess out of a mass of equations the qualitative result. Several months ago, I came upon live audio recordings of *The Feynman Lectures on Physics* and was amazed by the clarity and ingenuity of Feynman's view on physics. His discussion of gyrometer brought to me the similar process of charged particle moving in crossed electric and magnetic fields.

His description of radiation referred to different branches of physics, giving a pleasant unified picture. I recommended the recordings to my friends and held informal meetings to exchange ideas inspired by Professor Feynman. Because, as he put it, *you do not understand physics unless you can obtain the result from equations without carrying out calculation.*

Abstraction and intuition fit together seamlessly: intuitional understanding supplies sources to abstract, while abstraction provides me a broader view and imagination. That is what Fermi once told Friedman what the only valuable contributions to theoretical physics are, namely that bearing firmness and generality of mathematical construction and that entertaining people with physics intuition. But in undergraduate studies, I am not specialized as a theoretical physicist yet. There are other things which contribute to my academic career.

In many areas computer is an important, if not crucial, tool to study and research. Sometimes a mathematically simple fact, like superposition of circular polarized light of different amplitudes and frequencies, can not be imagined easily. But after making an animation, one can understand its mechanism immediately. Sometimes a certain investigation bores me, I program and let the machine help me out. I devoted fair amounts of time teaching myself algorithms and advanced computer techniques by taking part in free software projects. Gradually, I came to appreciate *hacker's wisdom* from programmer community: **it is a desire to understand internal mechanisms to fit our needs, and a desire to do things cleverly to concentrate human intelligence on non-repetitive work to make us smarter and more creative.** I hacked around laboratories tweaking devices to produce special results, and was invited to design new teaching experiment for younger students. It was the same reason how I was made a server administrator on campus. The most important thing, after all, is that *hacker's wisdom* assists my understanding of nature, getting me open to more possibilities.

Having enough background knowledge, I am well prepared to study astrophysics. It is philosophically debatable, mathematically enjoyable, intuitively understandable and able to be computer aided. New discoveries coming out every year, it often revolutionarily reshapes our ideas about the universe and even social values. I dream to be a professor on astrophysics, to query the unknown, to "hack" the reality and to satisfy the curiosity within my heart.

Now, I am ready to get trained professionally in a PhD graduate program. Borrowing from Pólya's suggestions for future mathematicians, I need a right man to imitate and capable friends to compete with. I need to be advised by a stimulating teacher, under whose guidance I would practice with real astrophysical problems, shape my academic taste and make my first contribution.