**Personal Statement**

"Why is there a limit of speed in our universe?"

"You really never heard of a photon, a massless particle?"

"No way! If it works, a man could travel to the past and kill himself!"

Discussions like this occurred almost every day between my friends and I when we were merely 12-year-old schoolboys. G. Gamow's fantastic book *One Two Three…Infinity* amazed us by unveiling the magnificent laws hidden in the most familiar. Those intriguing concepts, which were far beyond the scope of our textbooks, greatly aroused my curiosity and inspired me to carefully observe in everyday life various phenomena related to optics, phonics, magnetism and so on, to apply theoretical knowledge to dig out reasons behind, and to devise simple experiments to examine my understanding. Guided by pure interests, a nascent idea of becoming a physicist began to bud in my heart. Since I am used to devoting myself to the realization of a goal once it is set, I worked diligently throughout my high school years, with a special focus on math and physics. As a Chinese Physics Olympiad award winner, I was admitted to Peking University to further actualize my career goal of a researcher in physical science.

Although my GPA suffered a bit from physical inadaptation at first, I never stopped working hard and improvement is made every year. Knowing that research is a long, hard battle, I also set high requirements of physical exercise for myself and haven't even caught a cold for two years. In my junior year, I have started the study of several graduate courses like Advanced Quantum Mechanics, Group Theory, and Surface Physics to place myself closer to the frontier of modern science.

My actual research experiences begin with the superstar material, graphene, under the supervision of Professor Zhongfan Liu in the College of Chemistry and Molecular Engineering. Starting from learning how to properly hold tweezers, I gained hands-on experience in controllable Chemical Vapor Deposition (CVD) growth of graphene, and its transference between substrates. By slightly modifying the traditional CVD method, we realized the stable synthesis of twisted bilayer graphene. This work, as a patent *Multilayer Graphene and Its Synthesis Method*, has been received by China Patent Office. Later, I developed the image-processing procedure to support a hole-etching based method to identify polycrystalline graphene domains with optical microscopic images.

With enhanced experimental skills, I joined Prof. Jian Wang's group specializing in scanning tunneling microscopy (STM). Through massive literature reading, I grow familiar with the basics of STM and its applications in the study of high-temperature superconductors. I developed the know-how about quasiparticle interference (QPI) analysis, wrote the analyzing code, and applied it to one-unit-cell $FeSe/SrTiO_3$ to provide concrete evidence for orbital selective Cooper pairing. I also wrote the drift-correction program and formed a better understanding of the experiment errors unique to STM. We are collecting the results into a paper *Orbital Selective High-Temperature Cooper Pairing Developed at the Two Dimensional Limit* that will be submitted to *Nature Physics*. Another study I was engaged in was about the bernal stack (AB stack) bilayer graphene on SiC substrate. Through spectroscopic analysis I found weight transfer phenomena that implies electron correlations resembling Mott physics. The

results are being organized into another paper.

I also strove to diversify my perspectives and academic exposure to computational study of condensed matter systems, especially first-principle calculations. Now I have mastered the use of *Vienna Ab-initio Simulation Package* and have some experience with *Linux* operating system. Through an investigation of the existing correction schemes for the calculations of charged defects with periodic cells, I had a taste of how people in the computation community do things. Now I am working to provide the Python code integrated with other libraries which may facilitate a more convenient correction procedure.

While experimentalists work in the top-down way by relating observed phenomenon to microscopic mechanisms, what computation does is to construct elegant micro-models to deduce the emergent behavior of a complex system, thus in a bottom-up fashion. I find both working ethics fascinating in their unique way.

These experiences nurtured my juvenile love of physics so that it matured and evolved into unwavering faith and enduring pursuit. I have prepared myself with both experimental and computational skills, both to delve deeper into the area of condensed matter physics. The tactful communication and collaboration skills that I have developed through working in different groups make me quick to adapt and learn. The working experiences are expected to equip me with the ability to combine different approaches to challenge the hardest problems.

(Shan Zhong)