To whom it may concern,

# After more than three years’ education and research experiences in physics, I am convinced that ongoing researches in physics are both interesting and of great value. Among all subfields, quantum optics and photonics are my specific interest. ETH’s physics is strong in this field with the contribution of Professor Esslinger and Professor Imamoglu, etc. Therefore I applied, and I believe I have the aptitude to perform good researches under the guidance of your program. I am aware that the strict prerequisite of the Excellence Scholarship & Opportunity Programme / Master Scholarship Programme, I still want to have a try.

I was fortunate to enter Peking University, where I got high-quality training in physics, mathematics and computer programming through fundamental and advanced courses. Because of personal tastes, I selected a lot of graduate level course such as group theory, cosmology, many body physics, quantum field theory and also audited the courses of differential geometry, topology, conformal field theory in school of mathematics. On the one hand, unfortunately, I do not belong to the top 10% in the physics program of Peking University. On the other hand, luckily, I do belong to the top 12% in the program. Considering the fierce competition in PKU, I think the 2% is a small epsilon which could be reasonably neglected.

In addition, there are lots of introductory courses and lectures to all subareas in physics. Through the introductory courses I have got some idea about each field, and have gain particular interest in condensed matter physics and quantum optics, and I was especially curious about the interaction between light field and condensed matter.

I started my undergraduate research on optomechanics in my fourth term in professor Yun-Feng Xiao’s group. (“Xiao” is a common last name in China) Prof. Xiao assessed my theoretical background and assigned me the project on optomechanical coupling between optical microcavity and graphene. Incorporating graphene is advantageous because graphene’s prominent mechanical property will enhance the optomechanical coupling and the mechanical quality factor. Some aspects of the previous theoretical frame of optomechanics remain “classical” because the quantum noise coming from the material of the oscillator has been neglected. Though a heavy-burdened sophomore then, I made great efforts to teach myself many body physics and the theory of quantum noise to understand and reproduce the results from literature about optical and transport properties of graphene and the quantum noise spectrum in optomechanical system. After some research and numerical simulation, I successfully incorporated the language of condensed matter into optomechanics, and proposed a new kind of dissipative optomechanical coupling based upon modulating absorption rather than the leakage of light. Technically, a PhD student in our group had proposed similar system using carbon nanotubes before me, but she didn’t realize that some of the crucial quantum noise operators can’t be obtained within the frame of quantum optomechanics. I have thoroughly analyzed this “absorption based dissipative coupling” calculated the noise operators from material with Kubo formula and pointed out that these noise input would largely modulate the behavior of optomachanical system. My investigation also showed that ground state cooling of the graphene flexural mode can be achieved, making manipulation of graphene mechanical quantum states possible. This research work has been submitted to Phys. Rev. A recently (arXiv:1411.2202). I am now considering a suspended graphene which is somehow perpendicular to the mirror, and investigating the interaction between surface plasmon and cavity field, which will probably be my undergraduate thesis work.

Apart from my undergraduate project in quantum optomechanics, I have also tried some theoretical high energy physics research on TeV extra dimension on electron-positron colliders together with another senior student. We found that, in Higgs-strahlung process, some types of Randall-Sundrum model would deviate from Standard Model at tree level. We have calculated the several Feynman diagrams and corresponding cross sections. Our subsequent task would be comparing these cross sections with current data, estimating the upper limit of the scale of the fifth dimension and so on. Though I am not so confident in R-S model, because it introduces too many free variables to explain hierarchy problem, this research experience is priceless for me because through it I’ve got some first “feeling” of quantum field theory.

With the diverse research experiences, a little bit too diverse I guess, I find research work exciting and enjoyable and I have proved myself as a fast learner, a creative thinker and a good collaborator. I believe quantum optics would greatly push forward the understanding of quantum mechanics and facilitate the investigation of properties of condensed matter. Therefore I would like to pursue graduate study in this area, and I would love to be a researcher after graduation. ETH Zurich physics is known for its research achievement in quantum optics and cold atoms combining experiments and theories. Professor Imamoglu’s research on the interplay between quantum optics and mesoscopic condensed matter physics matches my undergraduate research and current research interest, and I am also interested in quantum many-body simulation with optical lattice, which is related to the research of professor Esslinger. Apart from academic reputation, as a poor guy who has been fed up with the air pollution in Beijing, I guess I would also love the blue sky and fresh air at Zurich. Therefore ETH Zurich Physics is the top choice for my graduate study. I hope my academic records and undergraduate research programs could justify and support my application of the scholarship.

Thank you very much for your time.