

Questions:

Question C:

In one or two sentences, describe your career goals and professional aspirations. This statement will be used in publications if you are selected as a scholar or honorable mention. (200 character limit including spaces)

Ph.D. in Quantum Computing. Conduct research aiming to build quantum processors and simulate quantum systems at the university level.

Question D:

What are your professional aspirations? Indicate in which area(s) of mathematics, science, or engineering you are considering making your career and specify how your current academic program and your overall educational plans will assist you in achieving this goal

Quantum Mechanics underpins all of condensed matter physics and modern chemistry. Using this theory to predict the behavior of many body systems can open doors to advances in clean energy, drug development and disease prevention. But our current computers are inept at simulating quantum systems. In 1982, physicist Richard Feynman proposed a radical solution: quantum computers. Forty years hence, we are on the path to realize his dream. However, near term quantum devices have limited resources while general purpose quantum computers are still decades away.

Given this, my primary goal as a physicist is to simulate many body systems using near term quantum computers.

To this end, I am pursuing a degree in Physics with a minor in Computer Science. When navigating the intersection of these two fields, I subscribe to the principle of doing more from less; taking a conservative course load but master courses which not only challenges my abilities but also enhance my research skill set. For example, through intermediate coursework in mechanics, electromagnetism and quantum mechanics, I learned about the first principles that underlie the field of quantum computing. Extensive training in concepts like the quantum harmonic oscillator has been crucial to my research in superconducting quantum systems.

On the other hand, courses in algorithms and computational theory have offered me a fresh perspective on assessing the relationship between computationally challenging problems. My minor in computer science also prepares me with valuable research skills such as programming and algorithmic analysis. With additional courses in condensed matter physics and microwave engineering, I intend to not only understand the systems I want to simulate but also the hardware through which I will simulate them.

Outside of academics, I have worked with research groups both on and off campus. In my earlier projects, I studied hybrid quantum-classical algorithms in calculating molecular ground states and solving graph problems. Currently, as a member of Superconducting

Quantum Systems Lab, I am exploring ways to encode quantum information in multimode cavities for simulation purposes. Aside from honing hard skills, these experiences have also strengthened my soft skills such as oral presentations to general and specific audiences, and large scale teamwork. Most importantly, research has been an avenue to meet inspiring scientists, strengthening my resolve to pursue a career in this field.

In graduate school, I will build upon this foundation by designing quantum systems that can simulate many body systems of interest. Upon completion of my PhD, I will pursue a research and teaching position at the university level, aiming to make significant contributions to the field.

Question E: Describe an activity or experience that has been important in clarifying or strengthening your motivation for a career in science, mathematics, or engineering

I wish to pursue a career in research, because it gives me a plethora of chances for self improvement. For example, before a grant presentation at Argonne National Lab, I presumed that I had good team-working skills. Whenever I had difficulty installing software or trouble understanding a task, I would refer to a friendly PhD student. But, I was oblivious to their work as I focused solely on my own.

That is why I was surprised to see a multitude of PhD students and postdocs also presenting their own projects at the grant meeting. As I listened to their talks, I was astounded by the parallels between their projects and my own. Some discussed problems related to mine. Others discussed approaches different from mine. Some of them deepened our line of work. Others assessed the broader impact of our work to COVID-19. I was left to wonder: How much more could I have contributed to the project if I had reached out to them outside group meetings, inquired about their challenges and assisted them in their work?

Through this reckoning, I re-realized the collaborative nature of research. My own little breakthroughs have not come from my mind but through listening more than talking in meetings, seeking and accepting feedback after presentations, and engaging in long email chains with researchers on the far corners of the world. It's working with other people, collaborating with them on projects, drawing inspiration from them that underlies my passion for research.

Question F: Goldwater Scholars will be representative of the diverse economic, ethnic, and occupational backgrounds of families in the United States. Describe any characteristics or other personal information about yourself or your family that you wish to share with the review committee.

I trace my childhood to a small town on the outskirts of New Delhi, India. My grandparents could only support the education of one of their three sons and they chose my father. My mother lost her father early on and had to support her mother on her own. Rising from such humble backgrounds, my parents, an engineer and a teacher, strived to provide their children, my sister and I, with the best education.

A family of four, we have tried hard to live in both worlds simultaneously, one in which my parents have climbed up on the ladder of opportunity to come to the US and the other in which our relatives struggle to make ends meet in India. Bridging both realities has required sacrifices on each of our parts, from sustaining financial strain to support family back in India to living separately for years at a time to care for my grandparents. And then the second wave of COVID-19 exacerbated that balance. As I watched my cousins scramble for oxygen cylinders in India, a feeling of helplessness coupled with a cruel lesson in privilege dawned upon me.
(Available upon request)

As a result, I have learned to take nothing for granted. I am beyond grateful for the research opportunities provided to me by my research supervisors and my teachers. More importantly, I want to extend my privileges to others through my research and outreach. Through this work, I hope to live up to the values espoused by my family.

Question G: In what way did COVID-19 or other hardships over the past couple of years affect your research career plans and did those events alter your ability to pursue those plans? If you have had to make changes, in what way(s) did you adapt to the situation? If COVID-19 did not influence your plans, simply state that there was no impact. Please note that your application will not be looked at less favorably in any way if you have not been significantly impacted.

While the COVID-19 crisis has not significantly impacted my research, it has changed my approach to it. Prior to COVID-19, my interest in quantum computing was purely an intellectual one. However, the present crisis has infused that curiosity with a sense of responsibility. Given that quantum computers can potentiate advances in modeling epidemics and drug development, I found a new meaning in my work. With a responsible curiosity, I will contribute but, above all, assist others in this patient yet crucial endeavor towards scientific progress.

