I have been interested in science and technology for as long as I can remember, and I have been particularly interested in solid state physics. The fact that designing and controlling the electronic devices that have permeated our world and our lives in recent decades requires an intricate knowledge of the atomic structure of the materials involved is fascinating. And even more impressive is that these characteristics can be manipulated by changing far less than 1% of the atoms in the crystal, and that this control allows us to create everything from toaster-ovens to iPods. It amazes me that all natural phenomena can be explained by mathematical formulas and the fundamental laws of physics. As such, my life has focused on gaining the knowledge necessary to understand these laws and mathematical techniques, and the limits of our current knowledge. And now that I am working toward a PhD in physics, I can see the current boundaries of this knowledge, and I will focus my efforts to expand these boundaries and to solve important problems facing the world today. In the following I will discuss my background, how my fascination with science has evolved over the years, the current problems facing the advancement of our knowledge, how my work and project will help solve these problems, and why I am an excellent candidate for the Wally Stoelzel Fellowship.

My interest in science was initiated while I was still in high-school. One of my physics teachers gave me a book to read about quantum physics, and I learned about the wave particle duality principle, where electrons have both particle and wave properties. From there, I was introduced to the double slit experiment where the wave and particle properties quantum systems are inseparable. In order to understand this phenomenon, I began reading physics books with an insatiable appetite. I learned about Shrödinger’s Equation, Heisenberg’s Uncertainty Principle, and the use of wave equations for describing semiconductors. It was then that I found experimental Solid State Physics to be a very interesting field.

When it was time to begin my undergraduate studies I decided to focus on applications of solid state physics. I studied Electrical Engineering and I received my Bachelor of Science degree, with honors, with an emphasis on Solid State Electronics. As an undergrad I conducted research with Dr. David Ferry and worked with graduate students to investigate and better understand the Quantum Hall Effect. In addition to conducting an honors research project, I was the lead engineer for the electrical group on a NASA satellite design project at ASU. We were focused on designing a micro-satellite, with a volume of 9000 cm3, which was meant to be attached to a shuttle. Once it reached Mars it detached from the shuttle and took pictures of the surface of Mars while in orbit. Our Electrical subsystem group focused on designing the power distribution circuits for the satellite, calculating the power budget for each system, and finding batteries capable of operating in the harsh conditions of space. This work impressed upon me the importance of continued research in solid-state physics, as finding long-lasting, high-power batteries is one of the most important problems in solid-state research today. Our design passed the preliminary review stage after we presented it to the Jet Propulsion Laboratory (JPL) in California.

After my Bachelor’s degree, I decided to further my education, and received a Master of Science degree in Electrical Engineering. My master’s project also focused on Solid State physics; I worked on an interdisciplinary bio-nano-molecular project. Our project was focused on designing a novel bio-sensor, imitating the function of Ion channels, to detect foreign analytes. I was involved in the fabrication of nano-pores in the cleanroom, characterizing nano-pores using Atomic Force Microscope (AFM), preparing biological samples, designing and fabricating micro-fluidic channels, and taking resistance measurements across the nano-pore with different buffer solutions. As part of a collaborative project I learned how to utilize my expertise in engineering and science to solve problems. My team work can be observed by referring to two publications based on my master’s degree project 1 2. I have also worked for two years in semiconductor industry where gained more insights of how academic experience could be applied to real situation problems.

As we have entered the 21st century our need in data storage has grown in many aspects such as science, media, internet, medical science and industry. However, we are approaching the limit for the Moore’s law and it will be harder now to double the density of transistors every two years because we are reaching levels where quantum effects dominate the transport. Also, other problems, such as energy loss and heat dissipation will rise as the number of transistors increases on a chip. To solve these problems, physicists have come up with a new area of research called spintronics, or spin transport electronics, which uses the spin of an electron to store and process information instead of the charge. The spin of an electron can be transported without any loss of energy. Since the spin of conduction electrons has a long life time, spintronic devices have gained attention in areas such as memory storage, magnetic sensors, and possibly quantum computing. However, to better improve this area, more devices with different designs and materials need to be studied. Also, phenomena such as the Exchange Bias, which influences spintronic devices, should be studied in more depth to develop better models. Currently, I am pursuing my PhD in Physics focusing on high density information storage of magnetic materials using Transmission Electron Microscopy (TEM) with Dr. David Smith. Recently, I passed my comprehensive exam and I am now a Physics PhD candidate. My research interests consist of studying spintronic devices with magnetic anisotropy normal to the film surface using High Resolution Electron Microscopy (HREM) and Electron holography to gain insights into their structure and function. These devices have promising applications for creating faster and smaller magnetic data storage devices. Also, as part of my research I would like to run simulations of these materials in conjunction with performing experiments. I am interested in understanding the depth of the Exchange Bias phenomenon, which still puzzles many scientists, from both experimental and theoretical aspects.

Once I establish myself in academic society I would like to become a professor, create my own lab with graduate students, and solve important scientific problems, such as overcoming the physical limits of Moore’s law by studying the physics of materials which have promising applications in electronics miniaturization. Minimizing electronics has and still have applications in every aspect of our lives such as computers, medical devices, healthcare, media, internet, space, cell phones and many more. However, as was explained earlier, there are challenges in minimizing electronics which are yet to be studied. I was once motivated by my great teachers, I would like to become a good mentor for my future students. Currently, I support myself by being a Teaching Assistant (TA). I also take classes, and perform research concurrently. I enjoy teaching and educating young minds; however, in order to graduate I need to perform certain amount of research, publish papers, and take required classes. Receiving the Wally Stoelzel scholarship will aid me in continuing my research and perform excellent in graduate school.

I believe that I should be considered for the Wally Stoelzel scholarship because of my curiosity in science, academic excellence, financial need, research experience, and enthusiasm to gain more knowledge. I hope that you would consider my application as a highly qualified candidate to receive this award.

**References**

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