Previous Research

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May 2003 - August 2003: After completing my first semester of undergraduate physics, I was accepted into a Research Experience for Undergraduates program at SRI International for the summer 2003. I worked for **Dr. Tom Slanger** and **Dr. Dave Huestis** in the molecular physics lab studying aeronomy and was introduced to programming with FORTRAN in UNIX and MS-DOS. The majority of my work was spent using a program called DIATOM, written by Dr. Huestis, to calculate orbital distributions of molecular spectra. We applied this method to several forbidden transitions of O_2 in Earth's upper atmosphere (i.e., nightglow). I co-authored a refereed paper on our results, published in Annales Geophysicae [2], and presented my results at the American Geophysical Union meeting in December 2003 [7].

June 2004 - August 2004: In the summer of 2004 I participated in the Science Undergraduate Laboratory Internship program at the Stanford Linear Accelerator Center. I worked for **Dr. Masao Sako**, a postdoc for **Dr. Roger Blandford**, searching for transient sources (supernovae) in overlapping images from the Sloan Digital Sky Survey (SDSS). I was in the Kavli Institute for Particle Astrophysics and Cosmology, KIPAC, devoting my time to writing scripts to reduce data. Dr. Sako and I sifted through overlapping mosaicked images from the SDSS in DS9 (a graphical interface software package for image analysis) for distinct changes in brightness. While we did not find any likely candidates, I learned a valuable lesson in research: in the search of one question, you may find answers to other unintended questions. We wrote paper on our discovery, published on the SLAC database [3], that the overall variability background of the sky is greater than previously thought.

January 2005 - May 2005: During the school year at the University of Southern California, I formulated a directed research class with my undergraduate astronomy advisor, **Dr. Werner Däppen**. We set up a curriculum for the course, calling it "Tools for the Working Astrophysicist." It was one-on-one, and taught me practical tools with FORTRAN, Linux, IDL, and numerical analysis. We made it a requirement that I write publication-style papers twice throughout the course, using real data. For my final project, I analyzed solar oscillation data in IDL and FORTRAN, implementing Fast-Fourier transforms to the raw data. I demonstrated in my final report how my experient confirmed the well known result that the Sun oscillates with very high nodes of frequency.

September 2004 - December 2005: I worked with **Dr. Donald Hoard** (Pomona College/ Caltech) and **Dr. Stefanie Wachter** at the Infrared Processing and Analysis Center (IPAC) at Caltech, studying binary star systems containing white dwarfs. As a small team, we used data and images from the 2-Micron All Sky Survey (2MASS) and from the *Spitzer Space Telescope* to determine their infrared properties. Most of the white dwarfs we analyzed are not optically verified, so I used old published finding charts and to determine the proper motion of stars between images from different epochs to positively identify the white dwarf for spectral analysis. The Palomar Optical Sky Survey 1 and 2 aided me in this endeavor, giving digitized images from the 1950s and 1980s, respectively. Coupled with 2MASS (circa 2000), we have thus far identified over 1000 white dwarfs, 130 of which display interesting characteristics that warrant further research. A paper detailing these results, which I co-authored, is due for publication shortly [1]. I am also contributing to a talk and a poster presentation on this subject at the January 2007 meeting of the American Astronomical Society (AAS) [5]. That summer, I accompanied Dr. Hoard and Dr. Wachter's postoc, **Dr. Carolyn Brinkworth**, on her observing run at Palomar Observatory for a night. I then assisted them on a week-long observing run on the 2.1m telescope at Kitt Peak National Observatory where we used the GoldCam longslit spectrometer to obtain spectra for several

white dwarfs. There, I learned how to operate the 2.1m telescope, and how to interpret preprocessed spectral data.

January 2005 - April 2005: I was a Research Experience for Undergraduates (REU) student researcher at the Cerro Tololo Inter-American Observatory (CTIO) in Chile. In addition to a 10-week project, groups of two students were in charge of a smaller "observing project" at the observatory on Cerro Tololo to operate the Yale 1.0m telescope and learn how to obtain images. We were responsible for the entire observing run while on the mountain, trading major tasks every other night. The first night I was responsible for pointing and operating the telescope and filling the dewer (the device attached to the telescope filled with nitrogen to chill the detector). The second night I used IRAF (the *Image Reduction and Analysis Facility*) to collect and assess the quality of the data. Our responsibilities involved determining the atmospheric extinction curves of several proposed objects beforehand, to maximize telescope time (as an object sets on the horizon, its light passes through increasingly more atmosphere, scattering the light). For my term project, I worked one-on-one with **Dr. Stella Kafka**, analyzing the old open cluster NGC 2141 for variable light sources (stars that change in brightness over time, such as eclipsing binary star systems that block each other's light as they orbit). Old open clusters, located in the disk of the galaxy, are useful tools in understanding the variability of stars for a particular age range, as all the stars in the cluster were formed at the same time, from the same star-birthing cloud. I worked extensively with IRAF to analyse the photometry of the images, gaining critical data-reduction experience. In particular, I employed the use of the software packages DAOPHOT and PSF, a point-source function fitting routine. I presented my initial results in a term paper and a talk at the end of the program, attended by over 50 astronomers from both CTIO and Gemini South, in addition to my peers. Of the 100 candidate variable stars catalogued thus far, two have been confirmed to be eclipsing binaries (these two in particular are "Algol-type"). The research experience resulted in a poster I will present at the January 2007 meeting of the AAS [6].

July 2006 - present: I am currently in my first semester of graduate school in the Astronomy Department at New Mexico State University. I arranged with my current advisor, **Dr. Chris Churchill**, to arrive early in the summer to begin work on Keck and UVES quasar (QSO) spectra. We are searching for metal line absorption in the spectra to study the physics of gas clouds in galaxies at high redshifts. I have since discovered over 30 new systems that are currently being analyzed by myself and others in the QSO team at NMSU, and am continuing this work presently. With other members of the QSO team at NMSU, I am co-author on a poster and will help present the characteristics of these new systems at the January 2007 meeting of the AAS [4].

Publications

[1] Hoard, D., Sturch, L., Widhalm, A. et al 2006, AJ, submitted

[2] Slanger, T., Cosby, P., Huestis, D., & Widhalm, A. 2004, Annales Geophysicae, 22, 3305

[3] Widhalm, A., & Sako, M. 2004, SLAC-TN-04-072

Poster Presentations at Meetings

[4] Churchill, C. et al [including Widhalm, A.] 2007, BAAS

[5] Hoard, D., Wachter, S., Sturch, L., Widhalm, A. et al 2007, BAAS

[6] Widhalm, A., Kafka, S. 2007, BAAS

[7] Widhalm, A., Slanger, T., Cosby, P., & Huestis, D. 2003, American Geophysical Union